STAT 390 A – Statistical Methods in Engineering and Science

Spring Quarter 2023

Instructor:	Prof. Alexander Giessing giessing@uw.edu	**Office Hours:**	Mon 11:00 AM – 12:00 PM (B-308 PDL)
TAs:	Qiliang Chen qlchen@uw.edu	**Office Hours:**	Thu 3:30 PM – 4:30 PM (STSC) Tue 10:30 AM – 11:30 AM (STSC)
	Dasha Petrov petrovd@uw.edu	**Office Hours:**	Wed 1:00 PM – 2:00 PM (STSC) Fri 10:15 AM – 11:15 AM (STSC)
Lectures:	Mon Wed Fri 2:30 – 3:20 PM	**Classroom:**	SMI 120
Labs:	Tue 8:30 – 9:20 AM (AA) Tue 9:30 – 10:20 AM (AB) Tue 1:30 – 2:20 PM (AC) Tue 2:30 – 3:20 PM (AD)	**Classroom:**	CMU B027
Course Page:	https://canvas.uw.edu/courses/1635461		

Course Description: This is a calculus-based introduction to probability and statistics for engineers and scientists. The first half of the course will provide mathematical background and probabilistic models to *describe* the real world. The second half will develop statistical methods to *learn* about the real world. Concepts discussed in this course include the axioms of probability theory, random variables, joint distributions, point estimation, confidence intervals, hypothesis testing, bootstrap, and simple linear regression. Statistical analyses of data sets and implementation of statistical methods using the software R form an integral part of this course.

Prerequisites: MATH 126 or MATH 136.

Lecture Notes and References: Lecture and lab notes will be posted on Canvas. There is no required textbook, but the following is a good addition to the lecture notes:

- Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences*, 9th edition, Cengage Learning.

Statistical Software: We will use the statistical software R. Please install free versions of R and RStudio before your first lab. There will be no lectures that explicitly teach you how to use R, but the TAs will provide some guidance in their labs. For a quick start, you might find these helpful:

- R tutorial by DataCamp
- Quick-R by DataCamp
- R tutorial on YouTube

- The Statistics Tutor and Study Center (STSC) in CMU B023 offers free tutoring on statistics that can help you with homework, studying for exams, and answering statistical questions.

Course Communication: Your TAs will manage and contribute to the discussion board on Canvas. This forum should be your first resource if you have questions. Your participation (both asking and answering questions) in the online discussion board factors into your participation grade. If you need to get in touch with Prof. Giessing directly, please use the Canvas messaging system. As this is a large class, the response time for these messages will typically be around 48 hours. Prof. Giessing will not respond to messages on any other platform, except in special circumstances (e.g. communicating with UW DRS).

Lectures: Regular attendance of the lectures is strongly recommended. The lectures cover many conceptual issues and statistical thinking that are not found in the textbook. They will appear in the midterm and final exam. Lectures also provide you the opportunity to ask questions. Historically, students who attend the lecture attain (on average) higher GPA.

Labs: Attending the labs is important to solidify your understanding of the lecture material through practice questions and discussions in a small group. Your participation also factors into your participation grade. Please attend the lab section which you are officially enrolled in.

Homework: There will be 9 problem sets, the best 8 will count equally to your final grade. Problem sets will be posted on Canvas. Please submit your solution in a single pdf or jpg. Late homework submissions on the due date will be penalized with 20%; homework that is one day late will be penalized with 60%; homework that is two or more days later will receive zero points. I do not grant extensions on homework assignments due to sickness. You are encouraged to work in groups of two or three students on the homework problems, please indicate your study group members on your homework submission. However, verbatim copying solutions is strictly forbidden; each student must produce their own solutions.

Exams: There will be a midterm and a final exam. The midterm exam will cover material of the first half of the course, the final exam will cover material from the second half. The exams are closed-book and closed-notes. You may use a simple, non-graphing calculator during the exams. The exams are required and there will not be any make-up exams; missing them will result in a grade of zero.

Schedule and Grade Policy:

Labs (5%) ..... every Tuesday, starting March 28, 2023
Homework (35%) ..... 10:00 PM at due dates
Midterm (25%) ..... Mon, 2:30 – 3:20 PM, April 26, 2023
Final (35%) ..... Tue, 2:30 – 4:20 PM, June 6, 2023

Final grades will be determined based on your percentage score that includes all of the components above. Grade percentages will be converted to final numeric grades. Grades will be curved. Percentages will correspond to at least the standard UW grade scale as follows:

Percentage	Grade	Percentage	Grade
10%	0.0	60%	2.4
20%	0.8	70%	2.8
30%	1.2	80%	3.2
40%	1.6	90%	3.6
50%	2.0	$> 98\%$	4.0

Response to COVID-19: You are required to familiarize yourself with the Statistics COVID-19 Prevention Plan, Policies, and Resources page.

Academic Integrity: Students shall abide by the University of Washington Academic Responsibility policies, which are outlined at https://depts.washington.edu/grading/pdf/AcademicResponsibility.pdf. Violations and suspected violations will be reported to the appropriate Dean's Representative and through the webpage for Community Standards and Student Conduct. The instructor reserves the right to assign a failing grade for the course for serious violations of student conduct. *Note: Use of websites, online forums, and/ or chatbots which provide solutions for class assignments is not allowed. You are also not allowed to distribute course materials to any individual or corporation outside of this course, STAT 390 A.*

Academic Accommodations: Your experience in this class is important to me. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so we can discuss how they will be implemented in this course. If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), contact DRS directly to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Contact DRS at disability.uw.edu.

Religious Accommodations: Washington state law requires that UW develop a policy for the accommodation of student absences or significant hardship due to reasons of faith or conscience or for organized religious activities. The UW's policy, including more information about requesting an accommodation, is available at Religious Accommodations Policy. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form.

Diversity and Inclusion: Diverse backgrounds, embodiments, and experiences are essential to the critical thinking endeavor at the heart of university education. Therefore, I expect you to follow the UW Student Conduct Code in your interactions with your colleagues and me in this course by respecting the many social and cultural differences among us, which may include, but are not limited to: age, cultural background, disability, ethnicity, family status, gender identity and presentation, citizenship and immigration status, national origin, race, religious and political beliefs, sex, sexual orientation, socioeconomic status, and veteran status.

Tentative Course Outline:

1. **Descriptive and Summary Statistics:** histogram, boxplots, sample mean, sample average, sample standard deviation.
2. **Axiomatic Introduction to Probability Theory:** sample space, events, (conditional) probability, independence of events, law of total probability, Bayes' rule, counting techniques.
3. **Random Variables:** discrete and continuous random variables, probability mass and density function, quantiles, expected value, standard deviation, transformations.
4. **Joint Distributions:** joint probability mass and density functions, covariance and correlation, independence of random variables.
5. **Asymptotic Results:** law of large numbers, central limit theorem, applications to probability theory.
6. **Statistical Models:** probabilistic vs. statistical models.
7. **Point Estimation:** method of moments, maximum likelihood, standard error, unbiasedness, efficiency.
8. **Bootstrap:** re-sampling principle, empirical boostrap, parametric bootstrap.
9. **Confidence Intervals:** intervals for normal data, large sample intervals, bootstrap intervals.
10. **Hypothesis Testing:** Neyman-Pearson framework, z- and t-tests, bootstrap tests.
11. **Comparison of Treatments:** inference based on two samples, analysis of paired data.